REMARKS/ARGUMENTS

The Applicant provides the following remarks and argument for consideration in further examination of the present application and explanation of the amendments presented herein.

Claim Amendments

Claims 10 and 19 are amended to correct a grammatical error in the article preceding the word "power," which should appropriately be "a" not "an."

Claim Rejections – 35 U.S.C. § 101

The final Office action again rejects claims 1-27 pursuant to 35 U.S.C. § 101 as directed to nonstatutory subject matter. The Office asserts that the claims "merely present a series of steps/computations without a useful, concrete, and tangible results. In particular, the result of the recited steps is merely a selection of a value based upon a series of calculations/comparisons." (Office Action, 28 September 2006, p. 3.) The Office suggests that there should be a limitation showing the application of the numerical value to produce some useful, concrete, and tangible result. Id. at p.2. Applicant disagrees and asserts that the claims as drafted and herein amended are directed to statutory subject matter and fully meet the requirements of § 101. In particular, Applicant requests the Office reconsider the rejection of the claims in view of the pronouncements regarding subject matter eligibility in *AT&T Corp.* v. *Excel Communications, Inc.*, 172 F.3d 1352 (Fed. Cir. 1999), a copy of which is attached hereto in Appendix A.

While an abstract idea per se does not constitute patentable subject matter, a claimed invention does meet the § 101 subject matter requirements when the abstract idea "has been reduced to some practical application rendering it 'useful.'" *AT&T*, 172 F.3d at 1356-57. The Court further states in *AT&T*, "that any step-by-step process, be it electronic, chemical, or mechanical, involves an "algorithm" in the broad sense of the term. *See State Street Bank & Trust Co. v. Signature Fin. Group, Inc.,* 149 F.3d 1368, 1374-75, 47 USPQ2d 1596, 1602 (Fed. Cir. 1998), *cert. denied,* 119 S. Ct. 851 (1999). Because Section 101 includes processes as a category of patentable subject matter, the judicially-defined proscription against patenting of a "mathematical algorithm," to the extent such a proscription still exists, is narrowly limited to mathematical algorithms in the abstract." *AT&T*, 172 F.3d at 1356, emphasis added.

Applicant notes that *State Street* and *AT&T* are the most recent, primary, and controlling pronouncements by the Court of Appeals for the Federal Circuit regarding the scope of

patentable subject matter under 35 U.S.C. § 101.[1] These and other cases form the substantive law by which examination of the claims in this application should be conducted. (See Interim *Guidelines for Examination of Patent Applications for Subject Matter Eligibility* (22 November 2005) p. 1 (the "Guidelines") ("These Guidelines do not constitute substantive rulemaking and do not have the force and effect of law. … Rejections will be issued on the substantive law and it is these rejections which are appealable.")

It should be clearly understood that physical transformation is not a requirement for patentability. (*See*, *AT&T*, 172 F.3d at 1358) ("The notion of 'physical transformation' can be misunderstood. In the first place, it is not an invariable requirement, but merely one example of how a mathematical algorithm may bring about a useful application." Emphasis added.) Additionally, with respect to method claims such as claims 1-9 in the present application, application of the process elements to a particular machine or other structure as suggested in the Office action (at p. 2) is entirely unnecessary under governing law and such a requirement by the Office is legally inappropriate. The Court made this very clear in *AT&T*:

> Excel also contends that because the process claims at issue lack physical limitations set forth in the patent, the claims are not patentable subject matter. This argument reflects a misunderstanding of our case law. The cases cited by Excel for this proposition involved machine claims written in means-plus-function language. *See, e.g., State Street,* 149 F.3d at 1371, 47 USPQ2d at 1599; *Alappat,* 33 F.3d at 1541, 31 USPQ2d at 1554. Apparatus claims written in this manner require supporting structure in the written description that corresponds to the claimed "means" elements. *See* 35 U.S.C. Section 112, para. 6 (1994). Since the claims at issue in this case are directed to a process in the first instance, a structural inquiry is unnecessary.
>
> The argument that physical limitations are necessary may also stem from the second part of the *Freeman-Walter-Abele* test, an earlier test which has been used to identify claims thought to involve unpatentable mathematical algorithms. That second part was said to inquire "whether the claim is directed to a mathematical algorithm that is not applied to or limited by physical elements." *Arrhythmia,* 958 F.2d at 1058, 22 USPQ2d at 1037. Although our en banc *Alappat* decision called this test "not an improper analysis," we then pointed out that "the ultimate issue always has been whether the claim as a whole is drawn to statutory subject matter." 33 F.3d at 1543 n.21, 31 USPQ2d at 1557 n.21. Furthermore, our recent *State Street* decision questioned the continuing viability

1 While issues regarding Section 101 were recently appealed to the Supreme Court in *Laboratory Corp. of America (LabCorp) v. Metabolite Laboratories, Inc.* (Supreme Court 2005), certiorari was dismissed as improvidently granted (548 U.S. ____ (2006) and the issued was not ruled upon. The Section 101 issues were not raised before the trial court or the Federal Circuit. *Metabolite Laboratories, Inc. et al. v. Laboratory Corp. of America (LabCorp)*, 03-1120 (Fed. Cir. June 8, 2004).

> of the *Freeman-Walter-Abele* test, noting that, "[a]fter *Diehr* and *Chakrabarty,* the *Freeman-Walter-Abele* test has little, if any, applicability to determining the presence of statutory subject matter." 149 F.3d at 1374, 47 USPQ2d at 1601. Whatever may be left of the earlier test, if anything, this type of physical limitations analysis seems of little value because "after *Diehr* and *Alappat,* the mere fact that a claimed invention involves inputting numbers, calculating numbers, outputting numbers, and storing numbers, in and of itself, would not render it nonstatutory subject matter, unless, of course, its operation does not produce a 'useful, concrete and tangible result.' " *Id.* at 1374, 47 USPQ2d at 1602 (quoting *Alappat,* 33 F.3d at 1544, 31 USPQ2d at 1557).
>
> Because we focus on the inquiry deemed "the ultimate issue" by *Alappat,* rather than on the physical limitations inquiry of the *Freeman-Walter-Abele* test, we find the cases cited by Excel in support of its position to be inapposite.

Id. at 1359-60, emphasis added, footnote omitted.

Thus, Applicant rejects the assertion by the Office that such physical or structural elements are required in the claims to render them statutory under Section 101. Even if this were the case, then claims 10-27 should be statutory under Section 101 as they all include physical or structural limitations. Further, even the method claims 1-10 indicate the use of the power management timer settings within a class of device having two power levels in which portions of the device are de-energized in the second power level state.

Although abstract ideas are not patentable subject matter when they are presented as "merely . . . constituting disembodied concepts or truths that are not 'useful,'" when abstract ideas are incorporated in a claimed invention as part of a process that produces a "useful, concrete, and tangible result," the invention satisfies § 101. *State Street,* 149 F.3d at 1373-75 (Fed. Cir. 1998). The result produced by the inventive method, system, and manufacture set forth in the claims is clearly "useful" in that the resulting power management timer setting based upon energy value calculations provides an optimal switching interval between power levels and when used by a device minimizes power usage of the device. Such an optimal switching interval embodied in the power management timer setting is clearly useful.

The calculating steps or functions in the claims of the present application are practically applied to produce a real-world result, i.e., the selection of a power management timer setting. That the timer setting itself is a numerical result is not an absolute bar to patentability because the power management timer setting has a tangible, real-life impact or consequence. When the timer setting is used in a device, the power usage of the device in idle periods is minimized. This

results in extended battery life for the device and thus an user's extended ability to use or operate the device. Such a result is clearly tangible.

The case of *Arrhythmia Research Technology Inc. v. Corazonix Corp.* is instructive on this point. 958 F.2d 1053 (Fed. Cir. 1992) (see Appendix B.) In *Arrhythmia* the Court upheld the statutory eligibility of the claimed subject matter[2] and stated, "In answering the question "What did the applicant invent?", *Grams*, 888 F.2d at 839, 12 USPQ2d at 1827, the [claimed] method is properly viewed as a method of analyzing electrocardiograph signals in order to determine a specified heart activity. … That the product is numerical is not a criterion of whether the claim is directed to statutory subject matter." 958 F.2d at 1059-60 (emphasis added). Thus the claims at issue in *Arrhythmia* are analogous to the claims of the present invention with respect to the tangibility of the recited result of the claimed process.

Further, from a legal standpoint, uses of algorithms that do not even go so far as to minimally report a result of a calculation have been found to be entirely appropriate practical applications meeting the requirements of Section 101. In fact, as compared to the representative claim 1 in *Arrhythmia*, the claims of the present application are arguably more tangible in that they require a selection of timer settings from among a plurality of possible settings based upon the estimated energy value, whereas the patent at issue in *Arrhythmia* merely compares two numbers, one a calculated result, the other predetermined. The determination of actual heart activity as a result is only derived from the claim implicitly.

In particular, the result in the claim of *Arrhythmia*, i.e., "a number representing a signal related to the patient's heart activity" was later characterized by the Court in *AT&T* as "a non-abstract output. … The finding that the claimed process "transformed" data from one "form" to another simply confirmed that Arrhythmia's method claims satisfied Section 101 because the mathematical algorithm included within the process was applied to produce a number which had specific meaning—a useful, concrete, tangible result—not a mathematical abstraction." 172 F.3d at 1359. Thus, even a mere numerical output of a process may be useful, concrete, and tangible

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2 Claim 1 of U.S. Patent No. 4,422,459 at issue in *Arrhythmia*, which was not rejected by the Office during prosecution as nonstatutory under Section 101, is as follows:

> 1. A method for analyzing electrocardiograph signals to determine the presence or absence of a predetermined level of high frequency energy in the late QRS signal, comprising the steps of:
>
> converting a series of QRS signals to time segments, each segment having a digital value equivalent to the analog value of said signals at said time;
>
> applying a portion of said time segments in reverse time order to high pass filter means;
>
> determining an arithmetic value of the amplitude of the output of said filter; and
>
> comparing said value with said predetermined level.

because of its specific meaning. The same is true of the present invention as claimed. The numerical output of the claimed processes (and further the claimed systems and computer program products) is not a mere mathematical abstraction; it has a specific meaning in the form of, *inter alia*, a correlation to a power management timer setting that effects the operation of a device that switches between multiple power levels. Applicant submits such is equally as tangible as a representation of a heart condition or activity.

While claim 1 in *Arrythmia* does differ in form from Applicant's method claims in that it recites a structure (a high pass filter means) particularly performing one of process steps, as discussed above, such a structural recitation is not required for a statutory claim. Id. at 1359-60. Additionally, even in claim 1 of *Arrythmia* there is no structure recited as performing the converting, determining, and comparing steps, and yet the claim was found to be statutory under Section 101.

Similarly, in *State Street* the claims[3] set forth a series of means for processing data regarding changes in value of an investment portfolio. The Court held "that the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces "a useful, concrete and tangible result"—a final share price momentarily fixed for recording and reporting purposes and even accepted and relied upon by regulatory authorities and in subsequent trades." 149 F.3d 1368. Note again that there was no requirement for doing anything with the results in any manner in *State Street*; it was enough to meet the statutory requirement of Section 101 that the numerical results were merely

3 Claim 1 of U.S. Patent No. 5,193,056 at issue in *State Street is as follows:*

> 1. A data processing system for managing a financial services configuration of a portfolio established as a partnership, each partner being one of a plurality of funds, comprising:
> (a) computer processor means for processing data;
> (b) storage means for storing data on a storage medium;
> (c) first means for initializing the storage medium;
> (d) second means for processing data regarding assets in the portfolio and each of the funds from a previous day and data regarding increases or decreases in each of the funds, [sic, funds'] assets and for allocating the percentage share that each fund holds in the portfolio;
> (e) third means for processing data regarding daily incremental income, expenses, and net realized gain or loss for the portfolio and for allocating such data among each fund;
> (f) fourth means for processing data regarding daily net unrealized gain or loss for the portfolio and for allocating such data among each fund; and
> (g) fifth means for processing data regarding aggregate year-end income, expenses, and capital gain or loss for the portfolio and each of the funds.

generated. The court implied the potential useful aspects of the results, e.g., for recording or reporting; such uses of the results were not presented explicitly in the claims.

The claims of the present invention similarly constitute a practical application of an algorithm that provides, *inter alia*, The calculation steps in the claims of the present application are practically applied to produce a real-world result, i.e., the selection of a power management timer setting. The power management timer setting has a tangible, real-life impact or consequence. When the timer setting is used in a device, the power usage of the device in idle periods is minimized. This results in extended battery life for the device and thus an user's extended ability to use or operate the device. Such a result is clearly tangible. Thus the description of tangible results of the process, system, and machine-readable mediums of the claims of the present application go well beyond the requirements set forth in the legal standards of prior controlling cases. Further note that although the claims at issue in *State Street* were directed entirely to a system, the legal principals apply equally to the system, product, and process claims of the present application. *AT&T*, 172 F.3d at 1357 ("[W]hether stated implicitly or explicitly, [the Court] consider[s] the scope of Section 101 to be the same regardless of the form—machine or process—in which the particular claim is drafted.").

In a further example, the claims at issue in *AT&T*[4] were directed to a "process employ[ing] subscribers' and call recipients' PICs [primary interexchange carrier] as data, appl[ying] Boolean algebra to those data to determine the value of the PIC indicator, and appl[ying] that value through switching and recording mechanisms to create a signal useful for billing purposes." 172 F.3d at 1358. Again, the useful, tangible result, i.e., creating a signal for billing purposes, is not actually recited in the claim. This use was implied by the Court. The claims of the present application may be similarly viewed in that the selection of the power management timer setting will implicitly have an effect on a device with multiple power levels selecting the setting.

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4 Claim 1 of U.S. Patent No. 5,333,184 at issue in *AT&T is as follows:*

> 1. A method for use in a telecommunications system in which interexchange calls initiated by each subscriber are automatically routed over the facilities of a particular one of a plurality of interexchange carriers associated with that subscriber, said method comprising the steps of:
>
> *generating a message record for an interexchange call* between an originating subscriber and a terminating subscriber, and
>
> including, in said message record, a primary interexchange carrier (PIC) indicator having a value which is a function of whether or not the interexchange carrier associated with said terminating subscriber is a predetermined one of said interexchange carriers.

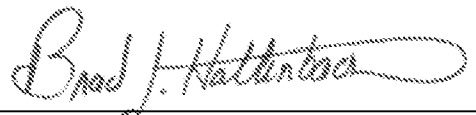
Finally, the claims produce a "concrete" result. As discussed in Applicant's prior response, by calculating the energy values for a series of tasks performed over a plurality of timer settings, a power management timer setting may be selected as a result The claimed invention yields a predictable, repeatable result in that the lowest energy value for a series of tasks over a range of timer settings will always be calculated and a optimal power management timer setting among the possible settings may always be determined as a result. Thus the "result" produced in the claims of the present application meets the "concrete" result factor as well.

Applicant asserts based upon the argument above in view of the controlling law, that the Office has failed to establish a prima facie case of unpatentability of the claims under Section 101 and that, as demonstrated above, the claims of the present application do in fact meet the requirements of Section 101 in conformance with the pronouncements of the Federal Circuit and the Supreme Court. Applicant thus requests reconsideration and withdrawal of the rejection pursuant to 35 U.S.C. § 101.

Conclusion

Applicant has addressed each of the issues raised in the final Office action through the arguments above. No additional rejections have been made during prosecution based upon references in the prior art. Thus Applicant believes all claims in the application are presently allowable and requests a notice of allowability be issued in due course. If the Examiner has any questions concerning this paper, the Examiner is encouraged to contact the undersigned counsel for Applicant in order to address any concerns and expeditiously place the application in condition for allowance.

Respectfully submitted this 26th day of December 2006.



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APPENDIX A

AT&T Corp. v. *Excel Communications, Inc.*, 172 F.3d 1352 (Fed. Cir. 1999)

AT & T Corp. v. Excel Communications Inc.
U.S. Court of Appeals Federal Circuit
April 14, 1999
172 F.3d 1352, 50 USPQ2d 1447

Plager, J.

This case asks us once again to examine the scope of section 1 of the Patent Act, 35 U.S.C. Section 101 (1994). The United States District Court for the District of Delaware granted summary judgment to Excel Communications, Inc., Excel Communications Marketing, Inc., and Excel Telecommunications, Inc. (collectively "Excel"), holding U.S. Patent No. 5,333,184 (the '184 patent) invalid under Section 101 for failure to claim statutory subject matter. *See AT & T Corp. v. Excel Communications, Inc.,* No. CIV.A.96-434-SLR, 1998 WL 175878, at *7 (D. Del. Mar. 27, 1998). AT & T Corp. ("AT & T"), owner of the '184 patent, appeals. Because we find that the claimed subject matter is properly within the statutory scope of Section 101, we reverse the district court's judgment of invalidity on this ground and remand the case for further proceedings.

Background

A.

The '184 patent, entitled "Call Message Recording for Telephone Systems," issued on July 26, 1994. It describes a message record for long-distance telephone calls that is enhanced by adding a primary interexchange carrier ("PIC") indicator. The addition of the indicator aids long-distance carriers in providing differential billing treatment for subscribers, depending upon whether a subscriber calls someone with the same or a different long-distance carrier.

The invention claimed in the '184 patent is designed to operate in a telecommunications system with multiple long-distance service providers. The system contains local exchange carriers ("LECs") and long-distance service (interexchange) carriers ("IXCs"). The LECs provide local telephone service and access to IXCs. Each customer has an LEC for local service and selects an IXC, such as AT & T or Excel, to be its primary long-distance service (interexchange) carrier or PIC. IXCs may own their own facilities, as does AT & T. Others, like Excel, called "resellers" or "resale carriers," contract with facility-owners to route their subscribers' calls through the facility-owners' switches and transmission lines. Some IXCs, including MCI and U.S. Sprint, have a mix of their own lines and leased lines.

<172 F.3d 1354> The system thus involves a three-step process when a caller makes a direct-dialed (1+) long-distance telephone call: (1) after the call is transmitted over the LEC's network to a switch, and the LEC identifies the caller's PIC, the LEC automatically routes the call to the facilities used by the caller's PIC; (2) the PIC's facilities carry the call to the LEC serving the call recipient; and (3) the call recipient's LEC delivers the call over its local network to the recipient's telephone.

When a caller makes a direct-dialed long-distance telephone call, a switch (which may be a switch in the interexchange network) monitors and records data related to the call, generating an "automatic message account" ("AMA") message record. This contemporaneous message record contains fields of information such as the originating and terminating telephone numbers,

and the length of time of the call. These message records are then transmitted from the switch to a message accumulation system for processing and billing.

Because the message records are stored in electronic format, they can be transmitted from one computer system to another and reformatted to ease processing of the information. Thus the carrier's AMA message subsequently is translated into the industry-standard "exchange message interface," forwarded to a rating system, and ultimately forwarded to a billing system in which the data resides until processed to generate, typically, "hard copy" bills which are mailed to subscribers.

B.

The invention of the '184 patent calls for the addition of a data field into a standard message record to indicate whether a call involves a particular PIC (the "PIC indicator"). This PIC indicator can exist in several forms, such as a code which identifies the call recipient's PIC, a flag which shows that the recipient's PIC is or is not a particular <50 USPQ2d 1449> IXC, or a flag that identifies the recipient's and the caller's PICs as the same IXC. The PIC indicator therefore enables IXCs to provide differential billing for calls on the basis of the identified PIC.

The application that issued as the '184 patent was filed in 1992. The U.S. Patent and Trademark Office ("PTO") initially rejected, for reasons unrelated to Section 101, all forty-one of the originally filed claims. Following amendment, the claims were issued in 1994 in their present form. The '184 patent contains six independent claims, five method claims and one apparatus claim, and additional dependent claims. The PTO granted the '184 patent without questioning whether the claims were directed to statutory subject matter under Section 101.

AT & T in 1996 asserted ten of the method claims against Excel in this infringement suit. The independent claims at issue (claims 1, 12, 18, and 40) include the step of "generating a message record for an interexchange call between an originating subscriber and a terminating subscriber," and the step of adding a PIC indicator to the message record. Independent claim 1, for example, adds a PIC indicator whose value depends upon the call recipient's PIC:

> A method for use in a telecommunications system in which interexchange calls initiated by each subscriber are automatically routed over the facilities of a particular one of a plurality of interexchange carriers associated with that subscriber, said method comprising the steps of:
> *generating a message record for an interexchange call* between an originating subscriber and a terminating subscriber, and *including, in said message record, a primary interexchange carrier (PIC) indicator* having a value which is *a function of whether or not the interexchange carrier associated with said terminating subscriber is a predetermined one* of said interexchange carriers.

(Emphasis added.) Independent claims 12 and 40 add a PIC indicator that shows if a <172 F.3d 1355> recipient's PIC is the same as the IXC over which that particular call is being made. Independent claim 18 adds a PIC indicator designed to show if the caller and the recipient subscribe to the same IXC. The dependent claims at issue add the steps of accessing an IXC's subscriber database (claims 4, 13, and 19) and billing individual calls as a function of the value of the PIC indicator (claims 6, 15, and 21).

The district court concluded that the method claims of the '184 patent implicitly recite a mathematical algorithm. *See AT & T,* 1998 WL 175878, at *6. The court was of the view that the only physical step in the claims involves data-gathering for the algorithm. *See id.* Though the court recognized that the claims require the use of switches and computers, it nevertheless

concluded that use of such facilities to perform a non-substantive change in the data's format could not serve to convert non-patentable subject matter into patentable subject matter. *See id.* at *6-7. Thus the trial court, on summary judgment, held all of the method claims at issue invalid for failure to qualify as statutory subject matter. *See id.* at *7.

Discussion

A.

Summary judgment is appropriate if there are no genuine issues of material fact and the moving party is entitled to judgment as a matter of law. *See* Fed. R. Civ. P. 56(c). We review without deference a trial court's grant of summary judgment, with all justifiable factual inferences drawn in favor of the party opposing the motion. *See Anderson v. Liberty Lobby, Inc.,* 477 U.S. 242, 255 (1986).

The issue on appeal, whether the asserted claims of the '184 patent are invalid for failure to claim statutory subject matter under 35 U.S.C. Section 101, is a question of law which we review without deference. *See Arrhythmia Research Tech. v. Corazonix Corp.,* 958 F.2d 1053, 1055-56, 22 USPQ2d 1033, 1035 (Fed. Cir. 1992). In matters of statutory interpretation, it is this court's responsibility independently to determine what the law is. *See Hodges v. Secretary of the Dep't of Health & Human Servs.,* 9 F.3d 958, 960 (Fed. Cir. 1993).

B.

Our analysis of whether a claim is directed to statutory subject matter begins with the language of 35 U.S.C. Section 101, which reads:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The Supreme Court has construed Section 101 broadly, noting that Congress intended statutory subject matter to "include anything under the sun that is made by man." *See Diamond v. Chakrabarty,* 447 U.S. 303, 309 <50 USPQ2d 1450> [206 USPQ 193] (1980) (quoting S. Rep. No. 82-1979, at 5 (1952); H.R. Rep. No. 82-1923, at 6 (1952)); *see also Diamond v. Diehr,* 450 U.S. 175, 182 [209 USPQ 1] (1981). Despite this seemingly limitless expanse, the Court has specifically identified three categories of unpatentable subject matter: "laws of nature, natural phenomena, and abstract ideas." *See Diehr,* 450 U.S. at 185.

In this case, the method claims at issue fall within the "process"[1] category of the four enumerated categories of patentable subject matter in Section 101. The district court held that the claims at issue, though otherwise within the terms of Section 101, implicitly recite a mathematical algorithm, *see AT & T,* 1998 WL 175878, at *6, and thus fall within the judicially created <172 F.3d 1356> "mathematical algorithm" exception to statutory subject matter.

A mathematical formula alone, sometimes referred to as a mathematical algorithm, viewed in the abstract, is considered unpatentable subject matter. *See Diamond v. Diehr,* 450 U.S. 175 [209 USPQ 1] (1981); *Parker v. Flook,* 437 U.S. 584 [198 USPQ 193] (1978); *Gottschalk v. Benson,* 409 U.S. 63 [175 USPQ 548] (1972). Courts have used the terms "mathematical algorithm," "mathematical formula," and "mathematical equation," to describe types of nonstatutory mathematical subject matter without explaining whether the terms are

interchangeable or different. Even assuming the words connote the same concept, there is considerable question as to exactly what the concept encompasses. *See, e.g., Diehr,* 450 U.S. at 186 n.9 ("The term 'algorithm' is subject to a variety of definitions... [Petitioner's] definition is significantly broader than the definition this Court employed in *Benson* and*Flook.*"); *accord In re Schrader,* 22 F.3d 290, 293 n.5, 30 USPQ2d 1455, 1457 n.5 (Fed. Cir. 1994).

This court recently pointed out that any step-by-step process, be it electronic, chemical, or mechanical, involves an "algorithm" in the broad sense of the term. *See State Street Bank & Trust Co. v. Signature Fin. Group, Inc.,* 149 F.3d 1368, 1374-75, 47 USPQ2d 1596, 1602 (Fed. Cir. 1998), *cert. denied,* ____ U.S. ____, 119 S. Ct. 851 (1999). Because Section 101 includes processes as a category of patentable subject matter, the judicially-defined proscription against patenting of a "mathematical algorithm," to the extent such a proscription still exists, is narrowly limited to mathematical algorithms in the abstract. *See id.: see also Benson,* 409 U.S. at 65 (describing a mathematical algorithm as a "procedure for solving a given type of mathematical problem").

Since the process of manipulation of numbers is a fundamental part of computer technology, we have had to reexamine the rules that govern the patentability of such technology. The sea-changes in both law and technology stand as a testament to the ability of law to adapt to new and innovative concepts, while remaining true to basic principles. In an earlier era, the PTO published guidelines essentially rejecting the notion that computer programs were patentable.[2] As the technology progressed, our predecessor court disagreed, and, overturning some of the earlier limiting principles regarding Section 101, announced more expansive principles formulated with computer technology in mind.[3] In our recent decision in *State Street,* this court discarded the so-called "business method" exception and reassessed the "mathematical algorithm" exception, *see* 149 F.3d at 1373-77, 47 USPQ2d at 1600, both judicially-created "exceptions" to the statutory categories of Section 101. As this brief review suggests, this court (and its predecessor) has struggled to make our understanding of the scope of Section 101 responsive to the needs of the modern world.

The Supreme Court has supported and enhanced this effort. In *Diehr,* the Court expressly limited its two earlier decisions in *Flook*and *Benson* by emphasizing that these cases did no more than confirm the "long-established principle" that laws of nature, natural phenomena, and abstract ideas are excluded from patent protection. 450 U.S. at 185. The *Diehr*<172 F.3d 1357> Court explicitly distinguished Diehr's process by pointing out that "the respondents here do not seek to patent a mathematical formula. Instead, they seek patent protection for a process of curing synthetic rubber." *Id.* at 187. The Court <50 USPQ2d 1451> then explained that although the process used a well-known mathematical equation, the applicants did not "pre-empt the use of that equation." *Id.* Thus, even though a mathematical algorithm is not patentable in isolation, a process that applies an equation to a new and useful end "is at the very least not barred at the threshold by Section 101." *Id.*at 188. In this regard, it is particularly worthy of note that the argument for the opposite result, that "the term 'algorithm'... is synonymous with the term 'computer program,' " *id.* at 219 (Stevens, J., dissenting), and thus computer-based programs as a general proposition should not be patentable, was made forcefully in dissent by Justice Stevens; his view, however, was rejected by the *Diehr* majority.

As previously noted, we most recently addressed the "mathematical algorithm" exception in *State Street. See* 149 F.3d at 1373-75, 47 USPQ2d at 1600. In *State Street,* this court, following the Supreme Court's guidance in *Diehr,* concluded that " [u]npatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied

concepts or truths that are not 'useful.'... [T]o be patentable an algorithm must be applied in a 'useful' way." *Id.*at 1373, 47 USPQ2d at 1601. In that case, the claimed data processing system for implementing a financial management structure satisfied the Section 101 inquiry because it constituted a "practical application of a mathematical algorithm,... [by] produc[ing] 'a useful, concrete and tangible result.' " *Id.*at 1373, 47 USPQ2d at 1601.

The *State Street* formulation, that a mathematical algorithm may be an integral part of patentable subject matter such as a machine or process if the claimed invention as a whole is applied in a "useful" manner, follows the approach taken by this court en banc in *In re Alappat,* 33 F.3d 1526, 31 USPQ2d 1545 (Fed. Cir. 1994). In *Alappat,* we set out our understanding of the Supreme Court's limitations on the patentability of mathematical subject matter and concluded that:

> [The Court] never intended to create an overly broad, fourth category of [mathematical] subject matter excluded from Section 101. Rather, at the core of the Court's analysis... lies an attempt by the Court to explain a rather straightforward concept, namely, that certain types of mathematical subject matter, *standing alone,* represent nothing more than*abstract ideas until reduced to some type of practical application,* and thus that subject matter is not, in and of itself, entitled to patent protection.

Id. at 1543, 31 USPQ2d at 1556 (emphasis added). Thus, the *Alappat* inquiry simply requires an examination of the contested claims to see if the claimed subject matter as a whole is a disembodied mathematical concept representing nothing more than a "law of nature" or an "abstract idea," or if the mathematical concept has been reduced to some practical application rendering it "useful." *Id.* at 1544, 31 USPQ2d at 1557. In *Alappat,* we held that more than an abstract idea was claimed because the claimed invention as a whole was directed toward forming a specific machine that produced the useful, concrete, and tangible result of a smooth waveform display. *See id.* at 1544, 31 USPQ2d at 1557.

In both *Alappat* and *State Street,* the claim was for a machine that achieved certain results. In the case before us, because Excel does not own or operate the facilities over which its calls are placed, AT & T did not charge Excel with infringement of its apparatus claims, but limited its infringement charge to the specified method or process claims. Whether stated implicitly or explicitly, we consider the scope of Section 101 to be the same regardless of the form – machine or process – in which a particular claim is drafted. *See, e.g., In* <172 F.3d 1358> *re Alappat,* 33 F.3d at 1581, 31 USPQ2d at 1589 (Rader, J., concurring) ("Judge Rich, with whom I fully concur, reads Alappat's application as claiming a machine. In fact, whether the invention is a process or a machine is irrelevant. The language of the Patent Act itself, as well as Supreme Court rulings, clarifies that Alappat's invention fits comfortably within 35 U.S.C. Section 101 whether viewed as a process or a machine."); *State Street,* 149 F.3d at 1372, 47 USPQ2d at 1600 (" [F]or the purposes of a Section 101 analysis, it is of little relevance whether claim 1 is directed to a 'machine' or a 'process,'...."). Furthermore, the Supreme Court's decisions in *Diehr, Benson,* and *Flook,* all of which involved method (i.e., process) claims, have provided and supported the principles which we apply to both machine- and process-type claims. Thus, we are comfortable in applying our reasoning in *Alappat* and *State Street* to the method claims at issue in this case.

C.

In light of this review of the current understanding of the "mathematical algorithm" exception, we turn now to the arguments of the parties in support of and in opposition to <50 USPQ2d 1452> the trial court's judgment. We note that, at the time the trial court made its decision, that court did not have the benefit of this court's explication in *State Street* of the mathematical algorithm issue.

As previously explained, AT & T's claimed process employs subscribers' and call recipients' PICs as data, applies Boolean algebra to those data to determine the value of the PIC indicator, and applies that value through switching and recording mechanisms to create a signal useful for billing purposes. In *State Street,* we held that the processing system there was patentable subject matter because the system takes data representing discrete dollar amounts through a series of mathematical calculations to determine a final share price – a useful, concrete, and tangible result. *See* 149 F.3d at 1373, 47 USPQ2d at 1601.

In this case, Excel argues, correctly, that the PIC indicator value is derived using a simple mathematical principle (p and q). But that is not determinative because AT & T does not claim the Boolean principle as such or attempt to forestall its use in any other application. It is clear from the written description of the '184 patent that AT & T is only claiming a process that uses the Boolean principle in order to determine the value of the PIC indicator. The PIC indicator represents information about the call recipient's PIC, a useful, non-abstract result that facilitates differential billing of long-distance calls made by an IXC's subscriber. Because the claimed process applies the Boolean principle to produce a useful, concrete, tangible result without pre-empting other uses of the mathematical principle, on its face the claimed process comfortably falls within the scope of Section 101. *See Arrhythmia Research Tech. Inc. v. Corazonix Corp.,* 958 F.2d 1053, 1060, 22 USPQ2d 1033, 1039 (Fed. Cir. 1992) ("That the product is numerical is not a criterion of whether the claim is directed to statutory subject matter.").

Excel argues that method claims containing mathematical algorithms are patentable subject matter only if there is a "physical transformation" or conversion of subject matter from one state into another. The physical transformation language appears in *Diehr, see* 450 U.S. at 184 ("That respondents' claims involve the transformation of an article, in this case raw, uncured synthetic rubber, into a different state or thing cannot be disputed."), and has been echoed by this court in *Schrader,* 22 F.3d at 294, 30 USPQ2d at 1458 ("Therefore, we do not find in the claim any kind of data transformation.").

The notion of "physical transformation" can be misunderstood. In the first place, it is not an invariable requirement, but merely one example of how a mathematical algorithm may bring about a useful application. As the Supreme Court itself noted, <172 F.3d 1359> "when [a claimed invention] is performing a function which the patent laws were designed to protect (e.g., transforming or reducing an article to a different state or thing), then the claim satisfies the requirements of Section 101." *Diehr,* 450 U.S. at 192 (emphasis added). The "e.g." signal denotes an example, not an exclusive requirement.

This understanding of transformation is consistent with our earlier decision in *Arrhythmia,* 958 F.2d 1053, 22 USPQ2d 1033 (Fed. Cir. 1992). Arrhythmia's process claims included various mathematical formulae to analyze electrocardiograph signals to determine a specified heart activity. *See id.* at 1059, 22 USPQ2d at 1037. The *Arrhythmia* court reasoned that the method claims qualified as statutory subject matter by noting that the steps transformed physical, electrical signals from one form into another form – a number representing a signal related to the patient's heart activity, a non-abstract output. *See id.,* 22 USPQ2d at 1038. The finding that the claimed process "transformed" data from one "form" to another simply confirmed that

Arrhythmia's method claims satisfied Section 101 because the mathematical algorithm included within the process was applied to produce a number which had specific meaning – a useful, concrete, tangible result – not a mathematical abstraction. *See id.* at 1060, 22 USPQ2d at 1039.

Excel also contends that because the process claims at issue lack physical limitations set forth in the patent, the claims are not patentable subject matter. This argument reflects a misunderstanding of our case law. The cases cited by Excel for this proposition involved machine claims written in means-plus-function language. *See, e.g., State Street,* 149 F.3d at 1371, 47 USPQ2d at 1599; *Alappat,* 33 F.3d at 1541, 31 USPQ2d at 1554. Apparatus claims written in this manner require supporting structure in the written description that corresponds to the claimed "means" elements. *See* 35 U.S.C. Section 112, para. 6 (1994). Since the claims at issue in this case are directed to a process in the first instance, a structural inquiry is unnecessary.

The argument that physical limitations are necessary may also stem from the second part of the *Freeman-Walter-Abele* <50 USPQ2d 1453> test,[4] an earlier test which has been used to identify claims thought to involve unpatentable mathematical algorithms. That second part was said to inquire "whether the claim is directed to a mathematical algorithm that is not applied to or limited by physical elements."*Arrhythmia,* 958 F.2d at 1058, 22 USPQ2d at 1037. Although our en banc *Alappat*decision called this test "not an improper analysis," we then pointed out that "the ultimate issue always has been whether the claim as a whole is drawn to statutory subject matter." 33 F.3d at 1543 n.21, 31 USPQ2d at 1557 n.21. Furthermore, our recent *State Street* decision questioned the continuing viability of the *Freeman-Walter-Abele* test, noting that, " [a]fter *Diehr* and *Chakrabarty,* the *Freeman-Walter-Abele*test has little, if any, applicability to determining the presence of statutory subject matter." 149 F.3d at 1374, 47 USPQ2d at 1601. Whatever may be left of the earlier test, if anything, this type of physical limitations analysis seems of little value because "after *Diehr* and *Alappat,* the mere fact that a claimed invention involves inputting numbers, calculating numbers, outputting numbers, and storing numbers, in and of itself, would not render it nonstatutory subject matter, unless, of course, its operation does not produce a 'useful, concrete and tangible result.' " *Id.* at 1374, 47 USPQ2d at 1602 (quoting *Alappat,* 33 F.3d at 1544, 31 USPQ2d at 1557).

Because we focus on the inquiry deemed "the ultimate issue" by *Alappat,* rather than on the physical limitations inquiry of <172 F.3d 1360> the *Freeman-Walter-Abele* test, we find the cases cited by Excel in support of its position to be inapposite. For example, in *In re Grams,* the court applied the *Freeman-Walter-Abele*test and concluded that the only physical step in the claimed process involved data-gathering for the algorithm; thus, the claims were held to be directed to unpatentable subject matter. *See* 888 F.2d 835, 839, 12 USPQ2d 1824, 1829 (Fed. Cir. 1989). In contrast, our inquiry here focuses on whether the mathematical algorithm is applied in a practical manner to produce a useful result. *In re Grams* is unhelpful because the panel in that case did not ascertain if the end result of the claimed process was useful, concrete, and tangible.

Similarly, the court in *In re Schrader* relied upon the *Freeman-Walter-Abele* test for its analysis of the method claim involved. The court found neither a physical transformation nor any physical step in the claimed process aside from the entering of data into a record. *See* 22 F.3d at 294, 30 USPQ2d at 1458. The *Schrader* court likened the data-recording step to that of data-gathering and held that the claim was properly rejected as failing to define patentable subject matter. *See id.* at 294, 296, 30 USPQ2d at 1458. The focus of the court in *Schrader*was not on whether the mathematical algorithm was applied in a practical manner since it ended its inquiry

before looking to see if a useful, concrete, tangible result ensued. Thus, in light of our recent understanding of the issue, the *Schrader* court's analysis is as unhelpful as that of *In re Grams.*

Finally, the decision in *In re Warmerdam,* 33 F.3d 1354, 31 USPQ2d 1754 (Fed. Cir. 1994) is not to the contrary. There the court recognized the difficulty in knowing exactly what a mathematical algorithm is, "which makes rather dicey the determination of whether the claim as a whole is no more than that." *Id.* at 1359, 31 USPQ2d at 1758. Warmerdam's claims 1-4 encompassed a method for controlling the motion of objects and machines to avoid collision with other moving or fixed objects by generating bubble hierarchies through the use of a particular mathematical procedure. *See id.* at 1356, 31 USPQ2d at 1755. The court found that the claimed process did nothing more than manipulate basic mathematical constructs and concluded that "taking several abstract ideas and manipulating them together adds nothing to the basic equation"; hence, the court held that the claims were properly rejected under Section 101. *Id.* at 1360, 31 USPQ2d at 1759. Whether one agrees with the court's conclusion on the facts, the holding of the case is a straightforward application of the basic principle that mere laws of nature, natural phenomena, and abstract ideas are not within the categories of inventions or discoveries that may be patented under Section 101.

D.

In his dissent in *Diehr,* Justice Stevens noted two concerns regarding the Section 101 issue, and to which, in his view, federal judges have a duty to respond:

> First, the cases considering the patentability of program-related inventions do not establish rules that enable a conscientious patent lawyer to determine with a fair degree of accuracy which, if any, program-related inventions will be patentable. <50 USPQ2d 1454> Second, the inclusion of the ambiguous concept of an "algorithm" within the "law of nature" category of unpatentable subject matter has given rise to the concern that almost any process might be so described and therefore held unpatentable.

Diehr, 450 U.S. at 219 (Stevens, J., dissenting).

Despite the almost twenty years since Justice Stevens wrote, these concerns remain important. His solution was to declare all computer-based programming unpatentable. That has not been the course the law has taken. Rather, it is now clear that computer-based programming constitutes patentable subject matter so long as the basic requirements of Section 101 are met. Justice Stevens's concerns can be addressed within that framework.

<172 F.3d 1361> His first concern, that the rules are not sufficiently clear to enable reasonable prediction of outcomes, should be less of a concern today in light of the refocusing of the Section 101 issue that *Alappat* and *State Street* have provided. His second concern, that the ambiguous concept of "algorithm" could be used to make any process unpatentable, can be laid to rest once the focus is understood to be not on whether there is a mathematical algorithm at work, but on whether the algorithm-containing invention, as a whole, produces a tangible, useful, result.

In light of the above, and consistent with the clearer understanding that our more recent cases have provided, we conclude that the district court did not apply the proper analysis to the method claims at issue. Furthermore, had the court applied the proper analysis to the stated claims, the court would have concluded that all the claims asserted fall comfortably within the broad scope of patentable subject matter under Section 101. Accordingly, we hold as a matter of

law that Excel was not entitled to the grant of summary judgment of invalidity of the '184 patent under Section 101.

Since the case must be returned to the trial court for further proceedings, and to avoid any possible misunderstandings as to the scope of our decision, we note that the ultimate validity of these claims depends upon their satisfying the other requirements for patentability such as those set forth in 35 U.S.C. Sections 102, 103, and 112. Thus, on remand, those questions, as well as any others the parties may properly raise, remain for disposition.

Conclusion

The district court's summary judgment of invalidity is reversed, and the case is remanded for further proceedings consistent with this opinion.

REVERSED & REMANDED.

[1] "Process" is defined in 35 U.S.C. Section 100(b) to encompass: " [a] process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material."

[2] *See, e.g.,* 33 Fed. Reg. 15581, 15609-10 (1968).

[3] *See In re Tarczy-Hornoch,* 397 F.2d 856, 158 USPQ 141 (CCPA 1968) (overruling the "function of a machine" doctrine); *see also In re Bernhart,* 417 F.2d 1395, 163 USPQ 611 (CCPA 1969) (discussing patentability of a programmed computer); *In re Musgrave,* 431 F.2d 882, 167 USPQ 280 (CCPA 1970) (analyzing process claims encompassing computer programs). For a more detailed review of this history, with extensive citation to the secondary literature, see Justice Stevens's dissent in *Diehr,* 450 U.S. at 193.

[4] See *In re Freeman,* 573 F.2d 1237, 197 USPQ 464 (CCPA 1978), as modified by *In re Walter,* 618 F.2d 758, 205 USPQ 397 (CCPA 1980), and *In re Abele,* 648 F.2d 902, 214 USPQ 682 (CCPA 1982).

APPENDIX B

Arrhythmia Research Technology Inc. v. Corazonix Corp., 958 F.2d 1053 (Fed. Cir. 1992)

Arrhythmia Research Technology Inc. v. Corazonix Corp.
U.S. Court of Appeals Federal Circuit
March 12, 1992
958 F.2d 1053, 22 USPQ2d 1033

Newman, J.

Arrhythmia Research Technology, Inc. appeals the grant of summary judgment by the United States District Court for the Northern District of Texas[1] declaring United States Patent No. 4,422,459 to Michael B. Simson (the '459 or Simson patent) invalid for failure to claim statutory subject matter under 35 U.S.C. Section 101. The court did not decide the question of infringement.

We conclude that the claimed subject matter is statutory in terms of section 101. The judgment of invalidity on this ground is reversed.

The Simson Invention

The invention claimed in the '459 patent is directed to the analysis of electrocardiographic signals in order to determine certain characteristics of the heart function. In the hours immediately after a heart attack (myocardial infarction) the victim is particularly vulnerable to an acute type of heart arrhythmia known as ventricular tachycardia. Ventricular tachycardia leads quickly to ventricular fibrillation, in which the heart ceases effectively to pump blood through the body. Arrhythmia Research states that 15-25% of heart attack victims are at high risk for ventricular tachycardia. It can be treated or prevented with certain drugs, but these drugs have undesirable and sometimes dangerous side effects. Dr. Simson, a cardiologist, sought a solution to the problem of determining which heart attack victims are at high risk for ventricular tachycardia, so that these persons can be carefully monitored and appropriately treated.

Heart activity is monitored by means of an electrocardiograph device, whereby electrodes attached to the patient's body detect the heart's electrical signals in accordance with the various phases of heart activity. The signals can be displayed in wave form on a monitor and/or recorded on a chart. It was known that in patients subject to ventricular tachycardia certain anomalous waves having very low amplitude and high frequency, known as "late potentials," appear toward the end of the QRS[2] segment of the electrocardiographic signal, that is, late in the ventricular contraction cycle. Dr. Simson's method of detecting and measuring these late potentials in the QRS complex, and associated apparatus, are the subject of the '459 patent.

<958 F.2d 1055> The '459 patent specification describes these procedures. Certain of the heart attack patient's electrocardiographic signals, those obtained from electrodes designated as X, Y, and Z leads, are converted from analog to digital values, and a composite digital representation of the QRS segment is obtained by selecting and averaging a large number of the patient's QRS waveforms. The anterior portion of the composite QRS waveform is first isolated, and then processed by a digital high pass filter in reverse time order; that is, backwards. This step of reverse time order filtering is described as the critical feature of the Simson invention, in that it enables detection of the late potentials by eliminating certain perturbations that obscure these signals. The root mean square of the reverse time filtered output is then calculated, as described in the specification, to determine the average magnitude of the anterior portion of the QRS complex. Comparison of the output, which is measured in microvolts, with a predetermined level of high frequency energy, indicates whether the patient is subject to ventricular tachycardia. That

is, if the root mean square magnitude is less than the predetermined level, then low amplitude, high frequency late potentials have been shown to be present, indicating a higher risk of ventricular tachycardia. If the root mean square is greater than the predetermined <22 USPQ2d 1035> level, high risk for ventricular tachycardia is not indicated.

Certain steps of the invention are described as conducted with the aid of a digital computer, and the patent specification sets forth the mathematical formulae that are used to configure (program) the computer. The specification states that dedicated, specific purpose equipment or hard wired logic circuitry can also be used.

The district court held that the method and apparatus claims of the Simson patent are directed to a mathematical algorithm, and thus do not define statutory subject matter. Claim 1 is the broadest method claim:

> 1. A method for analyzing electrocardiograph signals to determine the presence or absence of a predetermined level of high frequency energy in the late QRS signal, comprising the steps of:
> converting a series of QRS signals to time segments, each segment having a digital value equivalent to the analog value of said signals at said time;
> applying a portion of said time segments in reverse time order to high pass filter means;
> determining an arithmetic value of the amplitude of the output of said filter; and
> comparing said value with said predetermined level.

Claim 7 is a representative apparatus claim:

> 7. Apparatus for analyzing electrocardiograph signals to determine the level of high frequency energy in the late QRS signal comprising:
> means for converting X, Y, and Z lead electrocardiographic input signals to digital valued time segments;
> means for examining said X, Y, and Z digital valued time segments and selecting therefrom the QRS waveform portions thereof;
> means for signal averaging a multiplicity of said selected QRS waveforms for each of said X, Y, and Z inputs and providing composite, digital X, Y, and Z QRS waveforms;
> high pass filter means;
> means for applying to said filter means, in reverse time order, the anterior portion of each said digital X, Y, and Z waveform; and
> means for comparing the output of said filter means with a predetermined level to obtain an indication of the presence of a high frequency, low level, energy component in the filter output of said anterior portions.

The Patent and Trademark Office had granted the patent without questioning that its claims were directed to statutory subject matter under Section 101.

35 U.S.C. Section 101

Whether a claim is directed to statutory subject matter is a question of law. Although <958 F.2d 1056> determination of this question may require findings of underlying facts specific to the particular subject matter and its mode of claiming, in this case there were no disputed facts material to the issue. Thus we give plenary review to the question, with appropriate recognition of the burdens on the challenger of a duly issued United States patent. *See* 35 U.S.C. Section 282

(duly issued patent is presumed valid); *Interconnect Planning Corp. v. Feil,* 774 F.2d 1132, 1139, 227 USPQ 543, 548, (Fed. Cir. 1985) (statutory presumption of validity is based in part on recognition of the expertise of patent examiners).

A new and useful process or apparatus is patentable subject matter, as defined in 35 U.S.C. Section 101:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The Supreme Court has observed that Congress intended section 101 to include "anything under the sun that is made by man." *Diamond v. Chakrabarty,* 447 U.S. 303, 309, 206 USPQ 193, 197 (1980), *quoting* S. Rep. No. 1979, 82d Cong., 2d Sess., 5 (1952); H.R. Rep. No. 1923, 82d Cong., 2d Sess., 6 (1952). There are, however, qualifications to the apparent sweep of this statement. Excluded from patentability is subject matter in the categories of "laws of nature, physical phenomena, and abstract ideas". *Diamond v. Diehr,* 450 U.S. 175, 185, 209 USPQ 1, 7 (1981). A mathematical formula may describe a law of nature, a scientific truth, or an abstract idea. As courts have recognized, mathematics may also be used to describe steps of a statutory method or elements of a statutory apparatus. The exceptions to patentable subject matter derive from a lengthy jurisprudence, but their meaning was probed anew with the advent of computer-related inventions.

In *Gottschalk v. Benson,* 409 U.S. 63, 72, 175 USPQ 673, 676 (1972) the Court held that a patent claim that "wholly pre-empts" a mathematical formula used in a general purpose digital computer is directed solely to <22 USPQ2d 1036> a mathematical algorithm,[3] and therefore does not define statutory subject matter under section 101. The Court described the mathematical process claimed in *Benson* as "so abstract and sweeping as to cover both known and unknown uses of the BCD [binary coded decimal] to pure binary conversion", 409 U.S. at 68, 175 USPQ at 675, citing *O'Reilly v. Morse,* 56 U.S. (15 How.) 62, 113 (1852) for its holding that the patentee may not claim more than he has actually invented.

In *Parker v. Flook,* 437 U.S. 584, 591, 198 USPQ 193, 198 (1978) the Court explained that the criterion for patentability of a claim that requires the use of mathematical procedures is not simply whether the claim "wholly pre-empts" a mathematical algorithm, but whether the claim is directed to a new and useful process, independent of whether the mathematical algorithm required for its performance is novel. Applying these criteria the Court held nonstatutory a method claim for computer-calculating "alarm limits" for use in a catalytic conversion process, on the basis that "once that algorithm is assumed to be within the prior art, the application, considered as a whole, contains no patentable invention." *Flook,* 437 U.S. at 594, 198 USPQ at 199.

In accordance with *Flook,* the claims were analyzed to determine whether the process itself was new and useful, assuming the mathematical algorithm was "well known". *Id.* at 592, 198 USPQ at 198. As the jurisprudence developed, <958 F.2d 1057> inventions that were implemented by the mathematically-directed performance of computers were viewed in the context of the practical application to which the computer-generated data were put. The Court of Customs and Patent Appeals observed in *In re Bradley,* 600 F.2d 807, 811-112, 202 USPQ 480, 485 (CCPA 1979) *aff'd by an equally divided court, sub nom. Diamond v. Bradley,* 450 U.S. 381 [209 USPQ 97] (1981):

> It is of course true that a modern digital computer manipulates data, usually in binary form, by performing mathematical operations, such as addition, subtraction, multiplication, division, or bit shifting, on the data. But this is only *how* the computer does what it does. Of importance is the significance of the data and their manipulation in the real world, i.e., *what* the computer is doing. [Emphases in original]

Thus computers came to be generally recognized as devices capable of performing or implementing process steps, or serving as components of an apparatus, without negating patentability of the process or the apparatus. In *Diamond v. Diehr* the Court explained that non-statutory status under section 101 derives from the "abstract", rather than the "sweeping", nature of a claim that contains a mathematical algorithm. The Court stated:

> "While a scientific truth, or the mathematical expression of it, is not a patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be."

Diehr, 450 U.S. at 188, 209 USPQ at 8, quoting *Mackay Radio & Telegraph Co. v. Radio Corp. of America,* 306 U.S. 86, 94, 40 USPQ 199, 202 (1939). The mathematical algorithm in *Diehr* was the known Arrhenius equation, and the Court held that when the algorithm was incorporated in a useful process, the subject matter was statutory. The Court confirmed the rule that process steps or apparatus functions that entail computer-performed calculations, whether the calculations are described in mathematical symbols or in words, do not of themselves render a claim nonstatutory. *Diehr*, 450 U.S. at 187, 209 USPQ at 8. The Court clarified its earlier holdings,[4] stating that "[I]t is inappropriate to dissect the claims into old and new elements and then to ignore the presence of the old elements in the [section 101] analysis." *Id.* at 188, 209 USPQ at 9.

The Court thus placed the patentability of computer-aided inventions in the mainstream of the law. The ensuing mode of analysis of such inventions was summarized in *In re Meyer*, 688 F.2d 789, 795, 215 USPQ 193, 198 (CCPA 1982):

> In considering a claim for compliance with 35 USC 101, it must be determined whether a scientific principle, law of nature, idea, or mental process, which may <22 USPQ2d 1037> be represented by a mathematical algorithm, is included in the subject matter of the claim. If it is, it must then be determined whether such principle, law, idea, or mental process is applied in an invention of a type set forth in 35 USC 101.

The law crystallized about the principle that claims directed solely to an abstract mathematical formula or equation, including the mathematical expression of scientific truth or a law of nature, whether directly or indirectly stated, are nonstatutory under section 101; whereas claims to a specific process or apparatus that is implemented in accordance with a mathematical algorithm will generally satisfy section 101.

In applying this principle to an invention whose process steps or apparatus elements are described at least in part in terms of mathematical procedures, the mathematical procedures are considered in the context of the claimed invention as a whole. *Diehr*, <958 F.2d 1058> 450 U.S. at 188, 209 USPQ at 9. Determination of statutory subject matter has been conveniently conducted in two stages, following a protocol initiated by the Court of Customs and Patent Appeals in *In re Freeman*, 573 F.2d 1237, 197 USPQ 464 (CCPA 1978); modified after the Court's *Flook* decision by *In re Walter*, 618 F.2d 758, 205 USPQ 397 (CCPA 1980); and again after the Court's *Diehr* decision by *In re Abele*, 684 F.2d 902, 214 USPQ 682 (CCPA 1982).

This analysis has been designated the *Freeman-Walter-Abele*test for statutory subject matter. It is first determined whether a mathematical algorithm is recited directly or indirectly in the claim. If so, it is next determined whether the claimed invention as a whole is no more than the algorithm itself; that is, whether the claim is directed to a mathematical algorithm that is not applied to or limited by physical elements or process steps. Such claims are nonstatutory. However, when the mathematical algorithm is applied in one or more steps of an otherwise statutory process claim, or one or more elements of an otherwise statutory apparatus claim, the requirements of section 101 are met. The court explained in *Abele,* 684 F.2d at 907, 214 USPQ at 686:

> [P]atentable subject matter [is not limited] to claims in which structural relationships or process steps are defined, limited or refined by the application of the algorithm.
>
> Rather, *Walter* should be read as requiring no more than that the algorithm be "applied in any manner to physical elements or process steps," provided that its application is circumscribed by more than a field of use limitation or non-essential post-solution activity.

As summarized by the PTO in *Ex Parte Logan*, 20 USPQ2d 1465, 1468 (PTO Bd. Pat. App. and Interf. 1991), the emphasis is "on *what* the claimed method steps do rather than *how* the steps are performed". (Emphases in original)

Although the *Freeman-Walter-Abele* analysis is not the only test for statutory subject matter, *Meyer*, 688 F.2d at 796, 215 USPQ at 198, and this court has stated that failure to meet that test may not always defeat the claim, *In re Grams*, 888 F.2d 835, 839 12 USPQ2d 1824, 1827 (Fed. Cir. 1989), this analytic procedure is conveniently applied to the Simson invention.

Analysis

Arrhythmia Research states that the district court erred in law, and that the combination of physical, mechanical, and electrical steps that are described and claimed in the '459 patent constitutes statutory subject matter. Arrhythmia Research stresses that the claims are directed to a process and apparatus for detecting and analyzing a specific heart activity signal, and do not preempt the mathematical algorithms used in any of the procedures. Arrhythmia Research states that the patentability of such claims is now well established by law, precedent, and practice.

Corazonix states that the claims define no more than a mathematical algorithm that calculates a number. Corazonix states that in Simson's process and apparatus claims mathematical algorithms are merely presented and solved, and that Simson's designation of a field of use and post-solution activity are not essential to the claims and thus do not cure this defect. Thus, Corazonix states that the claims are not directed to statutory subject matter, and that the district court's judgment was correct.

A. The Process Claims

Although mathematical calculations are involved in carrying out the claimed process, Arrhythmia Research argues that the claims are directed to a method of detection of a certain heart condition by a novel method of analyzing a portion of the electrocardiographically measured heart cycle. This is accomplished by procedures conducted by means of electronic equipment programmed to perform mathematical computation.

Applying the *Freeman-Walter-Abele* protocol, we accept for the purposes of this analysis the proposition that a mathematical <22 USPQ2d 1038> <958 F.2d 1059> algorithm is included in the subject matter of the process claims in that some claimed steps are described in the specification by mathematical formulae. *See In re Johnson*, 589 F.2d 1070, 1078, 200 USPQ 199, 208 (CCPA 1979) ("Reference to the specification must be made to determine whether [claimed] terms indirectly recite mathematical calculations, formulae, or equations.") We thus proceed to the second stage of the analysis, to determine whether the claimed process is otherwise statutory; that is, we determine what the claimed steps do, independent of how they are implemented.

Simson's process is claimed as a "method for analyzing electrocardiograph signals to determine the presence or absence of a predetermined level of high-frequency energy in the late QRS signal". This claim limitation is not ignored in determining whether the subject matter as a whole is statutory, for all of the claim steps are in implementation of this method. The electrocardiograph signals are first transformed from analog form, in which they are obtained, to the corresponding digital signal. These input signals are not abstractions; they are related to the patient's heart function. The anterior portion of the QRS signal is then processed, as the next step, by the procedure known as reverse time order filtration. The digital filter design selected by Dr. Simson for this purpose, known as the Butterworth filter, is one of several known procedures for frequency filtering of digital waveforms. The filtered signal is further analyzed to determine its average magnitude, as described in the specification, by the root mean square technique. Comparison of the resulting output to a predetermined level determines whether late potentials reside in the anterior portion of the QRS segment, thus indicating whether the patient is at high risk for ventricular tachycardia. The resultant output is not an abstract number, but is a signal related to the patient's heart activity.

These claimed steps of "converting", "applying", "determining", and "comparing" are physical process steps that transform one physical, electrical signal into another. The view that "there is nothing necessarily physical about 'signals' " is incorrect. *In re Taner,* 681 F.2d 787, 790, 214 USPQ 678, 681 (CCPA 1982) (holding statutory claims to a method of seismic exploration including the mathematically described steps of "summing" and "simulating from"). The *Freeman-Walter-Abele* standard is met, for the steps of Simson's claimed method comprise an otherwise statutory process whose mathematical procedures are applied to physical process steps.

It was undisputed that the individual mathematical procedures that describe these steps are all known in the abstract. The method claims do not wholly preempt these procedures, but limit their application to the defined process steps. In answering the question "What did the applicant invent?", *Grams*, 888 F.2d at 839, 12 USPQ2d at 1827, the Simson method is properly viewed as a method of analyzing electrocardiograph signals in order to determine a specified heart activity. Like the court in *Abele,* which was "faced simply with an improved CAT-scan process", 684 F.2d at 909, 214 USPQ at 688, the Simson invention is properly viewed as an electrocardiograph analysis process. The claims do not encompass subject matter transcending what Dr. Simson invented, as in *O'Reilly v. Morse,* 56 U.S. (15 How.) at 113 (claims covered any use of electric current to transmit characters at a distance); or in *Benson,* 409 U.S. at 68, 175 USPQ at 675 (use of claimed process could "vary from the operation of a train to verification of driver's licenses to researching the law books for precedents"); or in *Grams*, 888 F.2d at 840, 12 USPQ2d at 1828 (invention had application to "any complex system, whether it be electrical, mechanical, chemical or biological, or combinations thereof.")

The Simson claims are analogous to those upheld in *Diehr,* wherein the Court remarked that the applicants "do not seek to patent a mathematical formula . . . they seek only to foreclose from others the use of that equation in conjunction with all of the other steps in their claimed process". 450 U.S. at 187, 209 <958 F.2d 1060> USPQ at 8. Simson's claimed method is similarly limited. The process claims comprise statutory subject matter.

B. The Apparatus Claims

The Simson apparatus for analyzing electrocardiographic signals is claimed in the style of 35 U.S.C. Section 112, paragraph 6, whereby functionally described claim elements are "construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof". Thus the statutory nature *vel non* of Simson's apparatus claims is determined with reference to the description in the '459 patent specification. *In re Iwahashi,* 888 F.2d 1370, 1375, 12 USPQ2d 1908, 1911-12 (Fed. Cir. 1989).

The apparatus claims require a means for converting the electrocardiograph signals from the analog form in which they are generated into digital form. This means is described in the specification as a specific electronic device, a conventional analog-to-<22 USPQ2d 1039> digital converter. A minicomputer, configured as described in the specification, is the means of calculating composite digital time segments of the QRS waveform. The product is stored, as stated in the specification, in the form of electrical signals. The high pass filter means is described in the specification as the minicomputer configured to perform the function of reverse time order filtration of the anterior portion of the QRS waveform. The specification and drawings show a disc memory unit to store the composite QRS signals, and associated connecting leads to the computer's processing unit. The comparing means is the processing unit configured to perform the specified function of root mean square averaging of the anterior portion of the QRS complex, and comparison of the resulting output with a predetermined level to provide an indication of the presence of late potentials in the electrocardiograph signal.

The Simson apparatus claims thus define "a combination of interrelated means" for performing specified functions. *Iwahashi,* 888 F.2d at 1375, 12 USPQ2d at 1911. The computer-performed operations transform a particular input signal to a different output signal, in accordance with the internal structure of the computer as configured by electronic instructions. "The claimed invention . . . converts one physical thing into another physical thing just as any other electrical circuitry would do". *In re Sherwood,* 613 F.2d 809, 819, 204 USPQ 537, 546 (CCPA 1980), *cert. denied,* 450 U.S. 994 [210 USPQ 776] (1981) (holding statutory claims to an apparatus for analyzing seismic signals including mathematically described means for "sonogramming", "dividing", and "plotting").

The use of mathematical formulae or relationships to describe the electronic structure and operation of an apparatus does not make it nonstatutory. *Iwahashi,* 888 F.2d at 1375, 12 USPQ2d at 1911. When mathematical formulae are the standard way of expressing certain functions or apparatus, it is appropriate that mathematical terms be used. *See W.L. Gore & Assoc., Inc. v. Garlock, Inc.,* 721 F.2d 1540, 1556, 220 USPQ 303, 315 (Fed. Cir. 1983), *cert. denied,* 469 U.S. 851 (1984) (patents are directed to those of skill in the art). *See also In re Bernhart*, 417 F.2d 1395, 1399, 163 USPQ 611, 616 (CCPA 1969) ("all machines function according to the laws of physics which can be mathematically set forth if known.") That Simson's claimed functions could not have been performed effectively without the speed and capability of electronic devices and components does not determine whether the claims are statutory.

Corazonix argues that the final output of the claimed apparatus (and process) is simply a number, and that *Benson* and *Flook*support the position that when the end product is a number, the claim is nonstatutory and can not be saved by claim limitations of the use to which this number is put. However, the number obtained is not a mathematical abstraction; it is a measure in microvolts of a specified heart activity, an indicator of the risk of ventricular tachycardia. That the product is numerical is not a criterion of whether the claim is directed to statutory subject matter. *See Meyer,* 688 F.2d at 796 n.4, 215 USPQ at <958 F.2d 1061> 198 n.4 (explaining that so-called "negative rules" of patentability "were not intended to be separate tests for determining whether a claim positively recites statutory subject matter.")

The Simson apparatus claims satisfy the criteria for statutory subject matter. They are directed to a specific apparatus of practical utility and specified application, and meet the requirements of 35 U.S.C. Section 101.

Conclusion

The judgment of invalidity on the ground that the claimed method and apparatus do not define statutory subject matter is reversed. The cause is remanded for resolution of remaining issues.

Taxable costs in favor of Arrhythmia Research.

REVERSED AND REMANDED

Rader, J., concurring.

Nearly twenty years ago, in *Gottschalk v. Benson,* 409 U.S. 63 [175 USPQ 458] (1972), the Supreme Court dealt with a computer process for conversion of binary coded decimals into pure binary numbers was not patentable subject matter. *Benson* held this mathematical algorithm ineligible for patent protection. 409 U.S. at 65, 71-72. Because computer programs rely heavily on mathematical algorithms, commentators saw dire implications in the Supreme Court's opinion for patent protection of computer software. For instance, one treatise, citing *Benson*, stated:

> [A] recent Supreme Court decision seemingly eliminated patent protection for computer software.

Donald S. Chisum, *Patents* Section 1.01 (1991); *see also id.* at Section 1.03 [6].

The court upholds the '459 patent by applying a permutation of the *Benson* algorithm rule. In reaching this result, the court <22 USPQ2d 1040> adds another cord to the twisted knot of precedent encircling and confining the *Benson* rule. While fully concurring in the court's result and commending its ability to trace legal strands through the tangle of post-*Benson* caselaw, I read later Supreme Court opinions to have cut the Gordian knot. The Supreme Court cut the knot by strictly limiting *Benson.*

Relying on the language of the patent statute, the Supreme Court in *Diamond v. Diehr*, 450 U.S. 175 [209 USPQ 1] (1981), turned away from the *Benson* algorithm rule. Thus, I too conclude that the '459 patent claims patentable subject matter – not on the basis of a two-step post-*Benson* test, but on the basis of the patentable subject matter standards in title 35. Rather than perpetuate a non-statutory standard, I would find that the subject matter of the '459 patent satisfies the statutory standards of the Patent Act.

I.

The questions presented by this case are whether the '459 patent claims a process and apparatus within the meaning of 35 U.S.C. Section 101 (1988). Section 101 states:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

According to this language, "any" invention or discovery within the four broad categories of "process, machine, manufacture, or composition of matter" is eligible for patent protection. "Any" is an expansive modifier which broadens the sweep of the categories. *See Diamond v. Chakrabarty,* 447 U.S. 303, 308-09 (1980). The language of section 101 conveys no implication that the Act extends patent protection to some subcategories of machines or processes and not to others.

The limits on patentable subject matter within section 101 focus not on subcategories of machines or processes, but on characteristics, such as newness and usefulness. Section 101 also specifies that, in addition to newness and usefulness, an invention or discovery must satisfy other "conditions and requirements." These other "conditions and requirements" encompass <958 F.2d 1062> characteristics like nonobviousness under 35 U.S.C. Section 103 (1988), or requirements like those in 35 U.S.C. Section 112 (1988). In other words, the language of the Patent Act does not suggest that the words "machine" or "process" carry limitations outside their ordinary meaning. *See Diehr,* 450 U.S. at 182 ("Unless otherwise defined, 'words will be interpreted as taking their ordinary, contemporary, common meaning' "). Rather the Act, by its terms, extends patent protection to "any" machine or process which satisfies the other conditions of patentability.

II.

In *Benson,* the Supreme Court encountered the question of whether a method for converting binary-coded decimals, which was useful in programming digital computers, was a patentable "process" under section 101. 409 U.S. at 64. The Court, by reading a limitation not found in the statute into the term "process," determined the method of conversion did not satisfy section 101.

In *Parker v. Flook*, 437 U.S. 584 [198 USPQ 193] (1978), the Court followed *Benson.* Flook claimed a method for updating alarm limits during catalytic conversion of hydrocarbons. The Court found Flook's method involving mathematical calculations – though applied to a post-solution use – unpatentable. *Flook*, 437 U.S. at 590. *Flook* clearly limited the *Benson* rule to mathematical formulae and mathematical algorithms. *Id.* at 585, 587, 589, 590, 591, 592, 594, 595. By mixing the terms "formula" and "algorithm," 437 U.S. at 585-86, however, *Flook*further confused the meaning of "mathematical algorithm." As used by *Benson,* that term meant "a procedure for solving a given type of mathematical problem." 409 U.S. at 65. Thus, an "algorithm" required both a mathematical problem and a solution procedure. A "formula" does not present or solve a mathematical problem, but merely expresses a relationship in mathematical terms. A "formula," even under *Benson* 's definition, is not an algorithm.

In the wake of *Benson, the Court of Customs and Patent Appeals* struggled to implement the algorithm rule.[1] Much of the difficulty sprang from the obscurity of the terms <22 USPQ2d 1041> invoked to preclude patentability – terms like "law of nature," "natural phenomena,"

"formulae," or "algorithm."[2] <958 F.2d 1063> *Benson*,409 U.S. at 65, 67; *Flook,* 437 U.S. at 593. In the context of a product's subject matter patentability, Justice Frankfurter discussed this analytical difficulty:

> It only confuses the issue, however, to introduce such terms as "the work of nature" and the "laws of nature." For these are vague and malleable terms infected with too much ambiguity and equivocation. Everything that happens may be deemed "the work of nature," and any patentable composite exemplifies in its properties "the laws of nature." Arguments drawn from such terms for ascertaining patentability could fairly be employed to challenge almost every patent.

Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 134-35 [76 USPQ 280] (1948) (Frankfurter, J., concurring). When attempting to enforce a legal standard embodied in broad, vague, nonstatutory terms, the courts have floundered.

At length, in *In re Freeman*, 573 F.2d 1237, 197 USPQ 464 (CCPA 1978) as modified by *In re Walter,* 618 F.2d 758, 205 USPQ 397 (CCPA 1980), the Court of Customs and Patent Appeals settled on a two-step test to detect unpatentable algorithms under the *Benson* rule:

> First, the claim is analyzed to determine whether a mathematical algorithm is directly or indirectly recited. Next, if a mathematical algorithm is found, the claim as a whole is further analyzed to determine whether the algorithm is "applied in any manner to physical elements or process steps," and, if it is, it "passes muster under Section 101."

In re Pardo, 684 F.2d 912, 915, 214 USPQ 673, 675-76 (CCPA 1982) (citing *In re Abele*, 684 F.2d 902, 214 USPQ 682 (CCPA 1982)). *Walter* adopted *Flook*'s implicit limitation of the *Benson*rule to "mathematical algorithms." 618 F.2d at 764-65 n.4. Like *Flook*,however, *Walter* confused "mathematical algorithms" with calculations, formulas, and mathematical procedures generally. *Id.*

Although downstream from *Benson*, this *Freeman-Walter*fork hid some of the same unnavigable cross-currents. In the first place, the term "mathematical algorithm" remained vague. Without a statutory anchor, this term was buffeted by every judicial wind until its course was indiscernible. The obscurity of the term "mathematical algorithm" is evident in two cases. In *Pardo,* 684 F.2d 912, the court narrowly limited "mathematical algorithm" to the execution of formulas with given data. In the same year, the court in *In re Meyer*, 688 F.2d 789, 215 USPQ 193 (CCPA 1982), sweepingly interpreted the same term to include any mental process that can be represented by a mathematical algorithm.

The second part of the test had similar uncertainties. The test did not suggest how many physical steps a claim must take to escape the fatal "mathematical algorithm" category. In *Abele,* 684 F.2d 902, the court upheld claims applying "a mathematical formula within the context of a process which encompasses significantly more than the algorithm alone." *Id.* at 909. Thus, the court apparently made compliance with the two-part test a function of the "significance" of additions to the algorithm – hardly a predictable standard.

The Court of Customs and Patent Appeals later clarified that the two-part algorithm is not the exclusive test for detecting unpatentable subject matter. *Meyer,* 688 F.2d at <22 USPQ2d 1042> 796. Indeed, the court abandoned the two-step test in *In re Taner*, 681 F.2d 787, 214 USPQ 678 (CCPA 1982).

With the advent of the Court of Appeals for the Federal Circuit, this court continued to grapple with the inherent vagueness of the two-part test for unpatentable algorithms. *See In re*

Grams, 888 F.2d 835, 12 USPQ2d 1824 (Fed. Cir. 1989); *In re Iwahashi,* 888 F.2d 1370, 12 USPQ2d 1980 (Fed. Cir. 1989). At one point, this court clarified <958 F.2d 1064> that failure to satisfy the second prong of the two-part test "does not necessarily doom the claim." *Grams,* 888 F.2d at 839. Instead this court recommended asking the broader question of "What did applicants invent?" in the context of the claim and its supporting disclosure. *Id.* At another point in the same opinion, this court put the central question in terms of whether "the claim in essence covers only the algorithm." *Id.*at 837.

Recognizing the obscurity of "algorithm," this court in *Iwahashi*attempted to "take the mystery out of the term":

> [W]e point out once again that every step-by-step process, be it electronic or chemical or mechanical, involves an algorithm in the broad sense of the term. Since Section 101 expressly includes processes as a category of inventions which may be patented and Section 100(b) further defines the word "process" as meaning "process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material," it follows that it is no ground for holding a claim is directed to nonstatutory subject matter to say it includes or is directed to an algorithm. This is why the proscription against patenting has been limited to *mathematical* algorithms . . .

888 F.2d at 1374 (emphasis in original). Because the Iwahashi claims as a whole described a machine or a manufacture (which fit within section 101 without regard to the meaning of "process"), this court in *Iwahashi*did not have occasion to resolve conflicts over the legal bounds of "mathematical algorithm."

In sum, the two-part test was cast in the crucible of confusion created by *Benson*. If the *Benson* algorithm rule was the last and binding word on the meaning of "process" under section 101, this court would be obligated to follow – regardless of any imprecision or ambiguity. The Supreme Court, however, has already shown another reading of the Patent Act.

III.

In *Diehr,* the Supreme Court adopted a very useful algorithm for determining patentable subject matter, namely, following the Patent Act itself. *Diehr* upheld claims to a process for curing synthetic rubber which included use of a mathematical computer process. After setting forth the procedural history of the case, the Supreme Court stated:

> In cases of statutory construction, we begin with the language of the statute.

Diehr, 450 U.S. at 182. Perhaps with an eye to the attempts to apply the *Benson* rule, the Court then noted:

> [I]n dealing with the patent laws, we have more than once cautioned that "courts 'should not read into the patent laws limitations and conditions which the legislature has not expressed.' "

Id. (citations omitted). Indeed Congress has never stated that section 101's term "process" excludes certain types of algorithms. Therefore, as *Diehr* commands, this court should refrain from employing judicially-created tests to limit section 101.

With that introduction, the Court proceeded to interpret the word "process" from section 101. In doing so, the Court briefly examined the history of patent laws back to 1793. *See also Chakrabarty,* 447 U.S. at 308-09. The Court summed up the legislative intent of the patent laws with this broad admonition:

> [T]he Committee Reports accompanying the 1952 Act . . . inform us that Congress intended statutory subject matter to "include anything under the sun that is made by man." S. Rep. No. 1979, 82d Cong., 2d Sess., 5 (1952); H.R. Rep. No. 1923, 82d Cong., 2d Sess., 6 (1952).

Diehr, 450 U.S. at 182. This passage underscores the fallacy of creating artificial limits for the words of the 1952 Act.

Courts should give "process" its literal and predictable meaning, without conjecturing about the policy implications of that literal reading. *Cf. Chakrabarty,* 447 U.S. at 316-18. If Congress wishes to remove some processes from patent protection, it can enact such an exclusion. Again, in the absence of legislated <958 F.2d 1065> limits on the meaning of the Act, courts should not presume to construct limits. The Supreme Court directed this court to follow the Act.

With that preface, the Supreme Court in *Diehr* specifically limited *Benson.* In the first place, the Court acknowledged the narrow definition of "mathematical algorithm" set forth by *Benson.* 450 U.S. 186 n.9. Moreover, the Court expressly stated:

> Our previous decisions regarding the patentability of "algorithms" are necessarily limited to the more narrow definition employed by the Court . . .

<22 USPQ2d 1043> *Id*. Thus, after *Diehr,* only a mathematical procedure for solution of a specified mathematical problem is suspect subject matter.

The Supreme Court in *Diehr* also limited *Benson* to a further narrow proposition. That narrow proposition supports reliance on the statutory language of the 1952 Act, rather than a nonstatutory algorithm rule.

Citing *Benson*, the Court in *Diehr* stated:

> This Court has undoubtedly recognized limits to Section 101 and every discovery is not embraced within the statutory terms. Excluded from such patent protection are laws of nature, natural phenomena, and abstract ideas.

Our recent holdings in *Gottschalk v. Benson*, *supra,* and *Parker v. Flook*, *supra,* both of which are computer-related, stand for no more than these long-established principles.

450 U.S. at 185. In *Taner,* 681 F.2d at 791, this court's predecessor said:

> [I]n *Diehr*, the Supreme Court made clear that *Benson*stands for no more than the long-established principle that laws of nature, natural phenomena, and abstract ideas are excluded from patent protection and that "a claim drawn to subject matter otherwise statutory does not become nonstatutory because it uses a mathematical formula, computer program, or digital computer." [Citations omitted.]

Thus, *Diehr* limited *Benson* and its progeny to three classes of unpatentable subject matter – laws of nature, natural phenomena, and abstract ideas. Indeed, in *Chakrabarty*, the Court also cited *Benson* for the proposition that these three categories are unpatentable. 447 U.S. at 309; *see also Flook*, 437 U.S. at 593.

Because the Supreme Court cited *Benson,* 450 U.S. at 185-86, this court has doubted whether *Diehr* limited the algorithm rule.*Grams,* 888 F.2d at 838. However, *In re Taner,* clearly interprets *Diehr* as strictly limiting *Benson.* 681 F.2d at 789, 791. More importantly, the Supreme Court instructed this court to apply the language of the 1952 Act without reading unexpressed limitations into the statute. *Diehr,* 450 U.S. at 182. Finally, to the extent that the *Benson* rule applies to mathematical algorithms in the wake of *Diehr,* the Supreme Court defined "mathematical algorithm" very narrowly.

By strictly limiting *Benson,* the Supreme Court signalled a change in the focus for patentability from the algorithm rule to the statutory standards of the Patent Act. The Supreme Court confined *Benson*to a narrow proposition which certainly does not preclude patentability of the '459 patent's heart attack risk detection process.

The '459 Patent

The '459 patent discloses an apparatus and a method for analyzing electrocardiograph signals to detect heart attack risks. The apparatus is a machine and is covered by the *Iwahashi* rule. The method converts an analog signal to a digital signal which passes, in reverse time order, through the mathematical equivalent of a filter. The filtered signal's amplitude is then measured and compared with a predetermined value.

The '459 invention manipulates electrocardiogram readings to render a useful result. While many steps in the '459 process involve the mathematical manipulation of data, the claims do not describe a law of nature or a natural phenomenon. Furthermore, the claims do not disclose mere abstract <958 F.2d 1066> ideas, but a practical and potentially life-saving process. Regardless of whether performed by a computer, these steps comprise a "process" within the meaning of section 101.

The district court granted summary judgment in favor of Corazonix because "the claims of the '459 patent are drawn to a nonstatutory mathematical algorithm and, as such, are unpatentable pursuant to the provisions of 35 U.S.C. Section 101." This erroneous conclusion illustrates the confusion caused by *Benson* and its progeny.

This conclusion is erroneous for several reasons. First, even if mathematical algorithms are barred from patentability,[3] the '459 patent as a whole does not present a mathematical algorithm. The '459 patent is a method for detecting the risk of a heart attack, not the presentation and proposed solution of a mathematical problem. In *Diehr,* the Supreme Court viewed the claims as "an industrial process for molding of rubber products," not a mathematical algorithm.<22 USPQ2d 1044> 450 U.S. at 186. The '459 patent's claims as a whole disclose a patentable process.

Second, the '459 patent does not claim a natural law, abstract idea, or natural phenomenon. *Diehr* limited the *Benson* rule to these three categories, none of which encompass the '459 patent.

Finally, and most important, *Diehr* refocused the patentability inquiry on the terms of the Patent Act rather than on non-statutory, vague classifications. Under the terms of the Act, a "process" deserves patent protection if it satisfies the Act's requirements. The '459 patent claims a "process" within the broad meaning of section 101. Therefore, this court must reverse and remand.

Conclusion

When determining whether claims disclosing computer art or any other art describe patentable subject matter, this court must follow the terms of the statute. The Supreme Court has focused this court's inquiry on the statute, not on special rules for computer art or mathematical art or any other art.

The claims of the '459 patent define an apparatus and a process. Both are patentable subject matter within the language of section 101. To me, the Supreme Court's most recent

message is clear: when all else fails (and the algorithm rule clearly has), consult the statute. On this basis, I, too, would reverse and remand.

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[1] *Arrhythmia Research Technology, Inc. v. Corazonix Corp.,* No. CA 3-88-1745-AJ (N.D. Tex. October 3, 1990), *reconsid. denied* (November 8, 1990) (Order); *appeal authorized* (November 9, 1990) (Order).

[2] According to Arrhythmia Research, the QRS complex lasts about one tenth of a second and arises from the depolarization of the ventricles prior to contraction.

[3] A mathematical algorithm was defined in*Benson* as a procedure or formula for solving a particular mathematical problem. 409 U.S. at 65, 175 USPQ at 674. As discussed in *In re Iwahashi,* 888 F.2d 1370, 1374, 12 USPQ2d 1908, 1911 (Fed. Cir. 1989), however, any step-by-step process, whether mechanical, electrical, biological or chemical, involves an "algorithm" in the broader sense of the term.

[4] Although commentators have differed in their interpretations of *Benson, Flook,* and *Diehr,* it appears to be generally agreed that these decisions represent evolving views of the Court, and that the reasoning in *Diehr* not only elaborated on, but in part superseded, that of *Benson* and *Flook. See, e.g.,* R.L. Gable & J.B. Leaheey, *The Strength of Patent Protection for Computer Products,* 17 Rutgers Computer & Tech. L.J. 87 (1991); D. Chisum, *The Patentability of Algorithms,* 47 U. Pitt. L. Rev. 959 (1986).

[1] *See, e.g., In re Christensen,* 478 F.2d 1392, 1396, 178 USPQ 35 (CCPA 1973) (Rich, J., concurring) ("The Supreme Court in *Benson* appears to have held that claims drafted in such terms are not patentable – for what reason remaining a mystery."), *overruled in part by In re Taner,* 681 F.2d 787, 214 USPQ 678 (1982); *In re Johnston,* 502 F.2d 765, 773, 183 USPQ 172, 179 (CCPA 1974) (Rich, J, dissenting) ("I am probably as much – if not more – confused by the wording of the *Benson* opinion as many others."); *rev'd, Dann v. Johnston,* 425 U.S. 219 [189 USPQ 257] (1976); *In re Chatfield,* 545 F.2d 152, 157, 191 USPQ 730, 735 (CCPA 1976) (Nonstatutory claims are "drawn to mathematical problem-solving algorithms or to purely mental steps."), *cert. denied, Dann v. Noll,* 434 U.S. 875 [195 USPQ 465] (1977).

[2] The Court in *Diamond v. Diehr,* 450 U.S. 175 [209 USPQ 1] (1981), expressly recognized that the term algorithm "is subject to a variety of definitions." 450 U.S. at 186 n.9. Even *Benson* 's definition for "algorithm" creates legal problems. For instance, the Benson-Tabbot algorithm worked with numbers, but "solved" a "mathematical problem" only in a very loose sense. Rather the Benson-Tabbot algorithm translated symbols from one numerical system to another. *Cf. In re Toma,* 575 F.2d 872, 197 USPQ 852 (CCPA 1978) (Using a digital computer to translate technical languages was not an algorithm.); *In re Freeman,* 573 F.2d 1237, 197 USPQ 464 (CCPA 1978) (Using computer to transcribe alphanumeric characters was not an algorithm.). Moreover some problems, even if expressed in mathematical terms, are not mathematical problems. Mathematics, like a language, is a form of expression. The operation of a machine, the generation of electricity, the reaction of two chemicals, a baseball batter's swing, a satellite's orbit – all are within the descriptive power of mathematics. The Court of Customs and Patent Appeals recognized this axiomatic point:

> However, some mathematical algorithms . . . represent ideas or mental processes and are simply logical vehicles for communicating possible solutions to complex problems.

In re Meyer, 688 F.2d 789, 794, 215 USPQ 193, 197 (CCPA 1982). No wonder the *Benson* rule is confusing when electrical, chemical, or mechanical processes escape scrutiny when expressed in written language, but become suspect when expressed in the mathematical language. In *In re Grams,* 888 F.2d 835, 12 USPQ2d 1824 (Fed. Cir. 1989), for instance, a medical diagnostic process was considered an unpatentable "mathematical algorithm" even though it did not present, or propose a solution to, a mathematical problem at all.

[3] The Court in *Diehr* stated: "we concluded that such an algorithm, or mathematical formula, is *like a law of nature,* which cannot be the subject of a patent." 450 U.S. at 186 (emphasis added). In fact, a mathematical algorithm does not appear in nature at all, but only in human numerical processes. A law of nature is indeed not patentable, but for reasons unrelated to the meaning of "process." A law of nature, even if a process, is not "new" within the meaning of Section 101. Moreover, in *Sarker,* this court's predecessor gave another reason a law of nature cannot satisfy section 101. *In re Sarker,* 588 F.2d 1330, 1333, 200 USPQ 132, 137 (CCPA 1978). In sum, the Patent Act excludes laws of nature from patent protection even without a strained explanation excluding laws of nature from the meaning of "process." It is difficult to determine how or why mathematical algorithms are "like" laws of nature.